

Measurement of Open Heavy Flavor with Single Muons in pp and dAu Collisions at 200 GeV

- Why Open Charm in pp, dAu collisions?
- Why with PHENIX muon arms?
- How to measure open charm?
- What have we learned?

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Motivation: why open charm?

■ pp collisions:

Provide the critical test for pQCD calculations of heavy-quark production

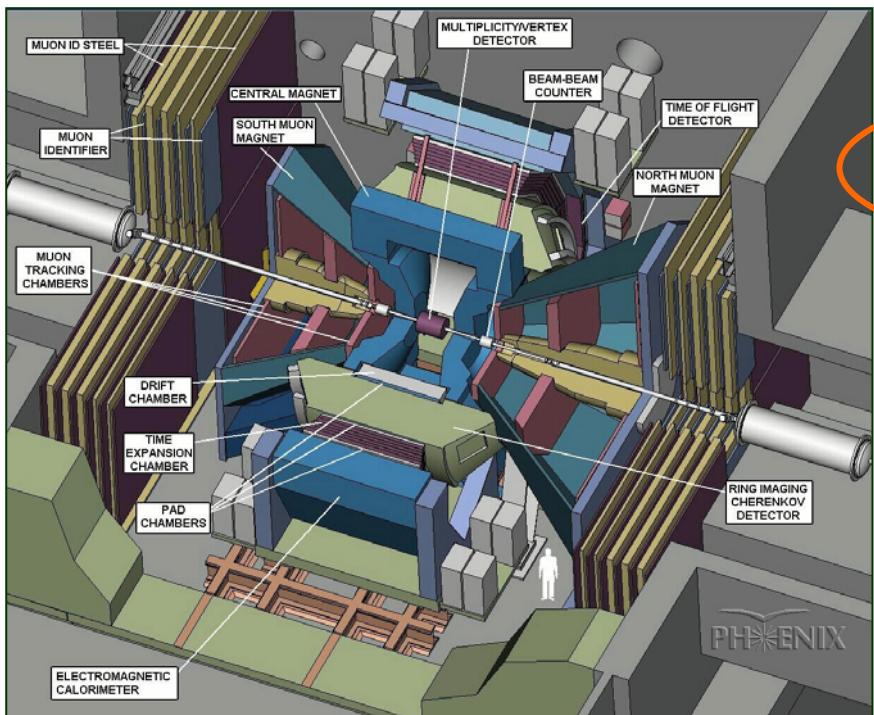
■ Probe cold nuclear medium effect in dAu collisions

- Gluon saturation/CGC at forward rapidity (small x) ?
 - Different scaling at different rapidity
- Coherent multiple scattering and X_B rescaling ?
- Recombination?

Open Heavy flavor measurement will provide more constraints on these models.

■ Open charm production serves as an appropriate normalization for J/psi production.

PHENIX detector

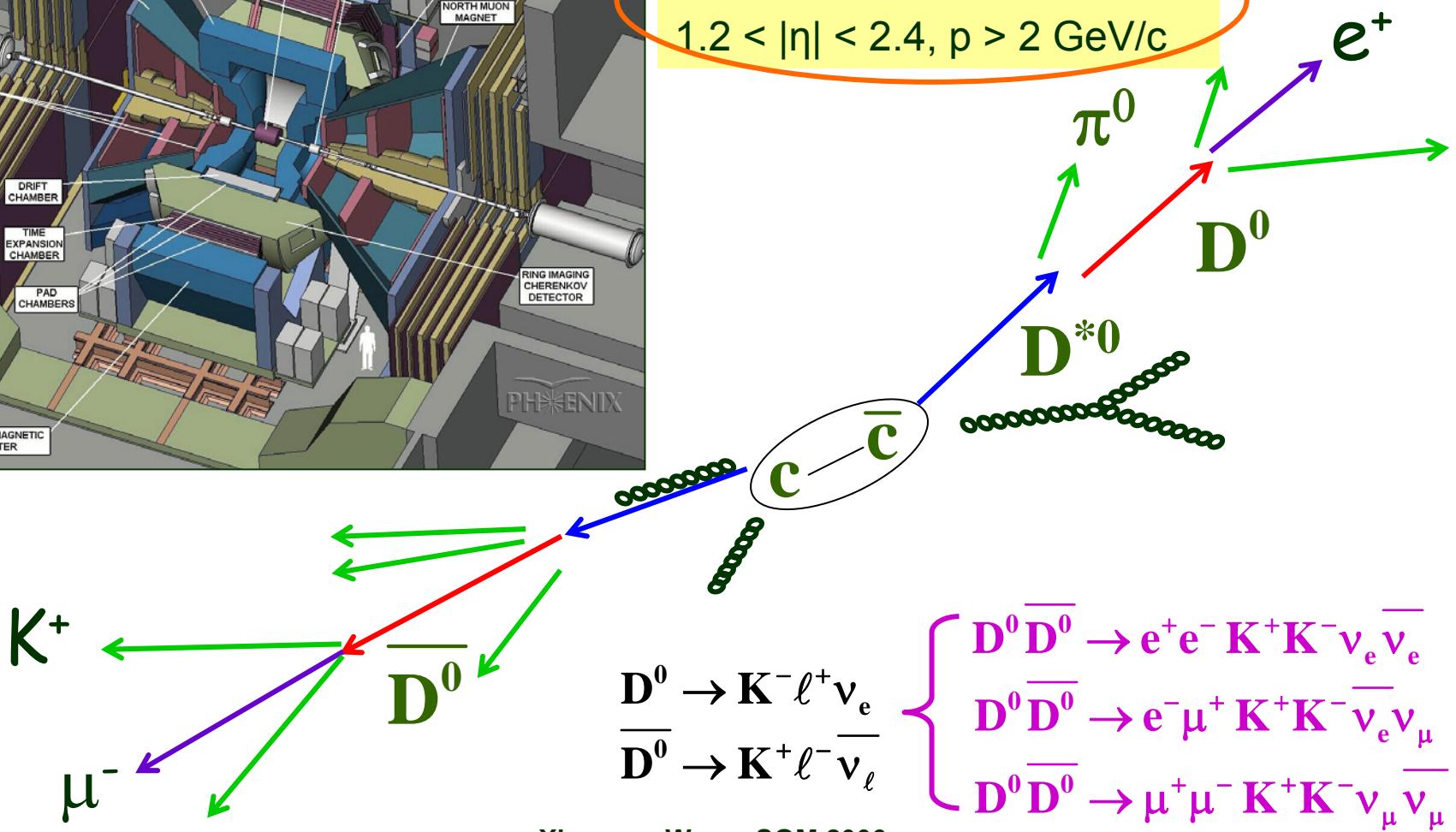


Electrons: central arms

$|\eta| < 0.35, p > 0.2 \text{ GeV}/c$

Muons: muon arms

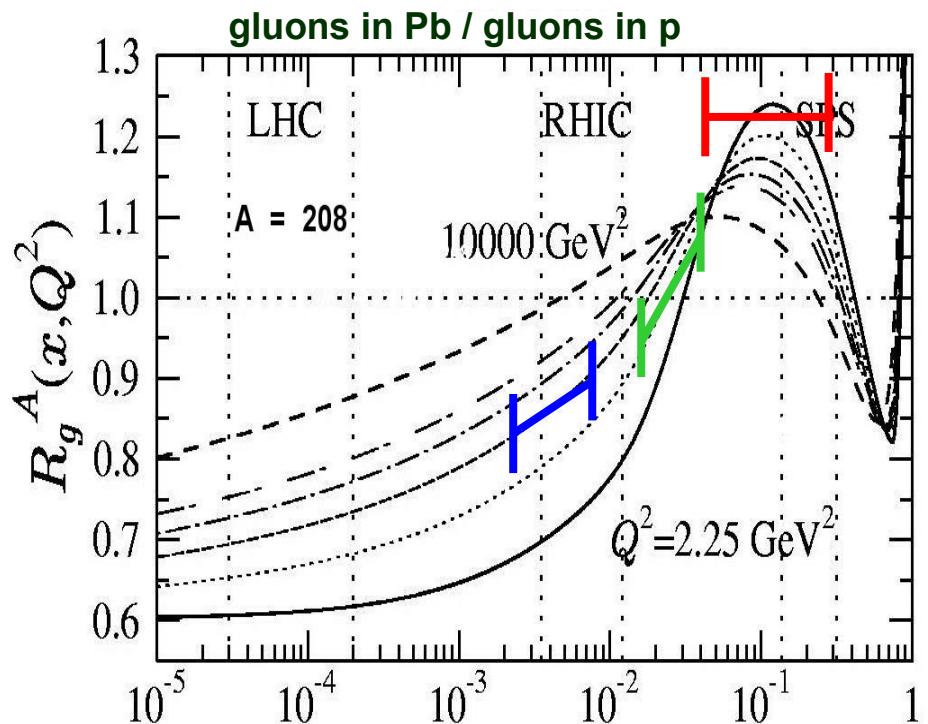
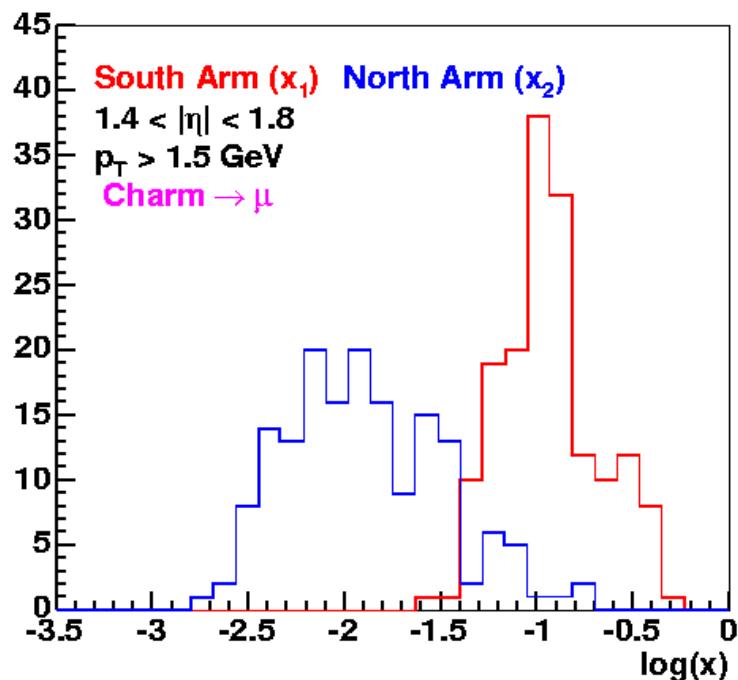
$1.2 < |\eta| < 2.4, p > 2 \text{ GeV}/c$



PHENIX muon arms “x” coverage

Particle production in the d direction (north) is sensitive to the small-x parton distribution in the Au nuclei; whereas in the gold (south) is sensitive to the large-x in Au

PYTHIA open charm simulation



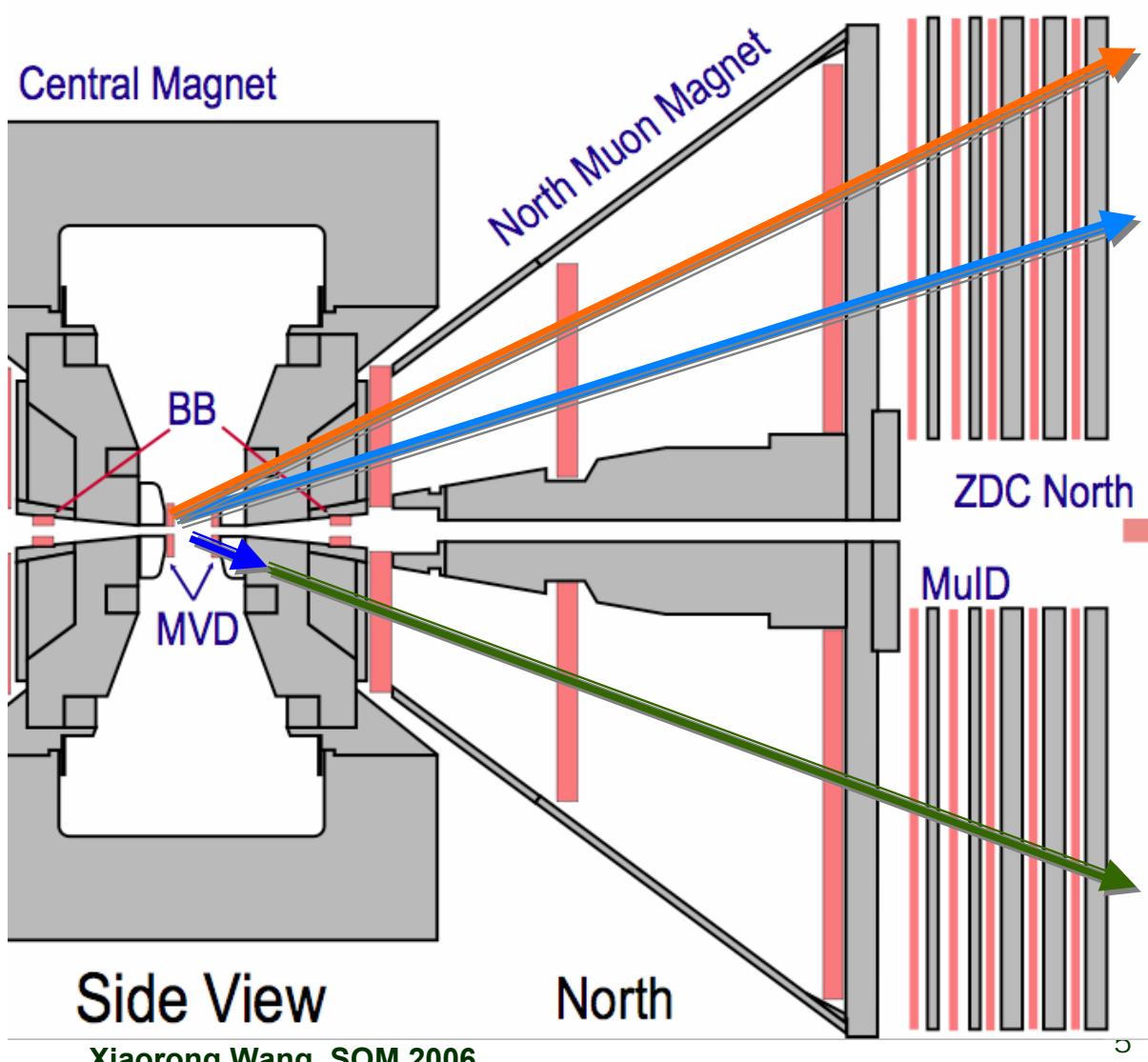
From Eskola, Kolhinen, Vogt
Nucl. Phys. A696 (2001) 729-746.

Experimental Challenge

Prompt Muons

Punch-through hadrons

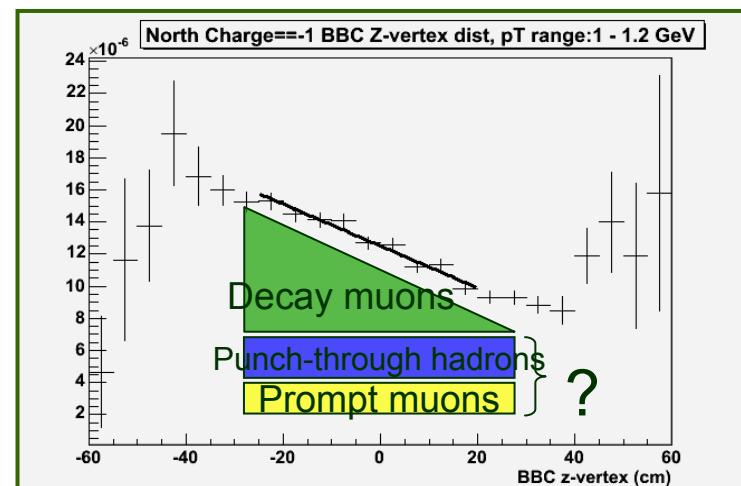
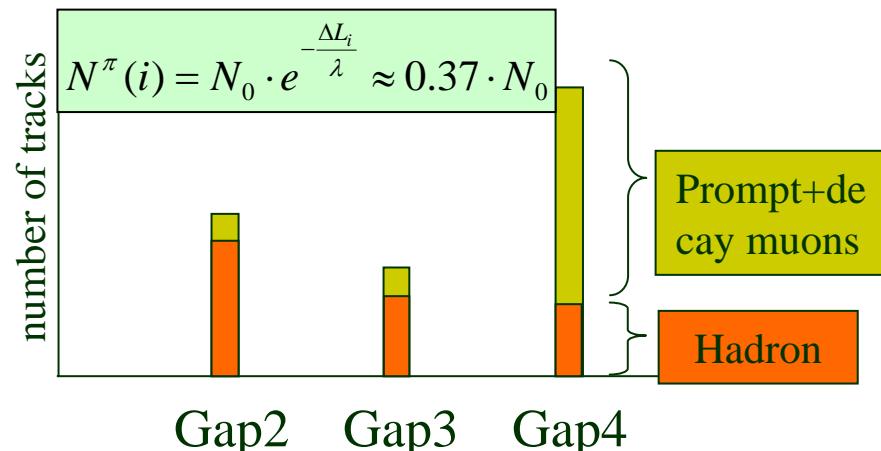
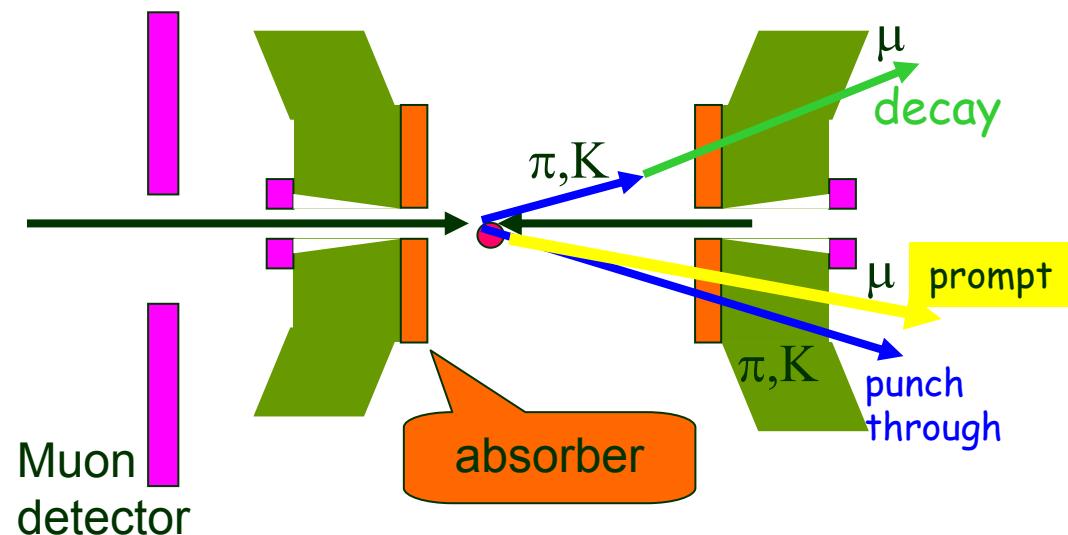
Decay Muon



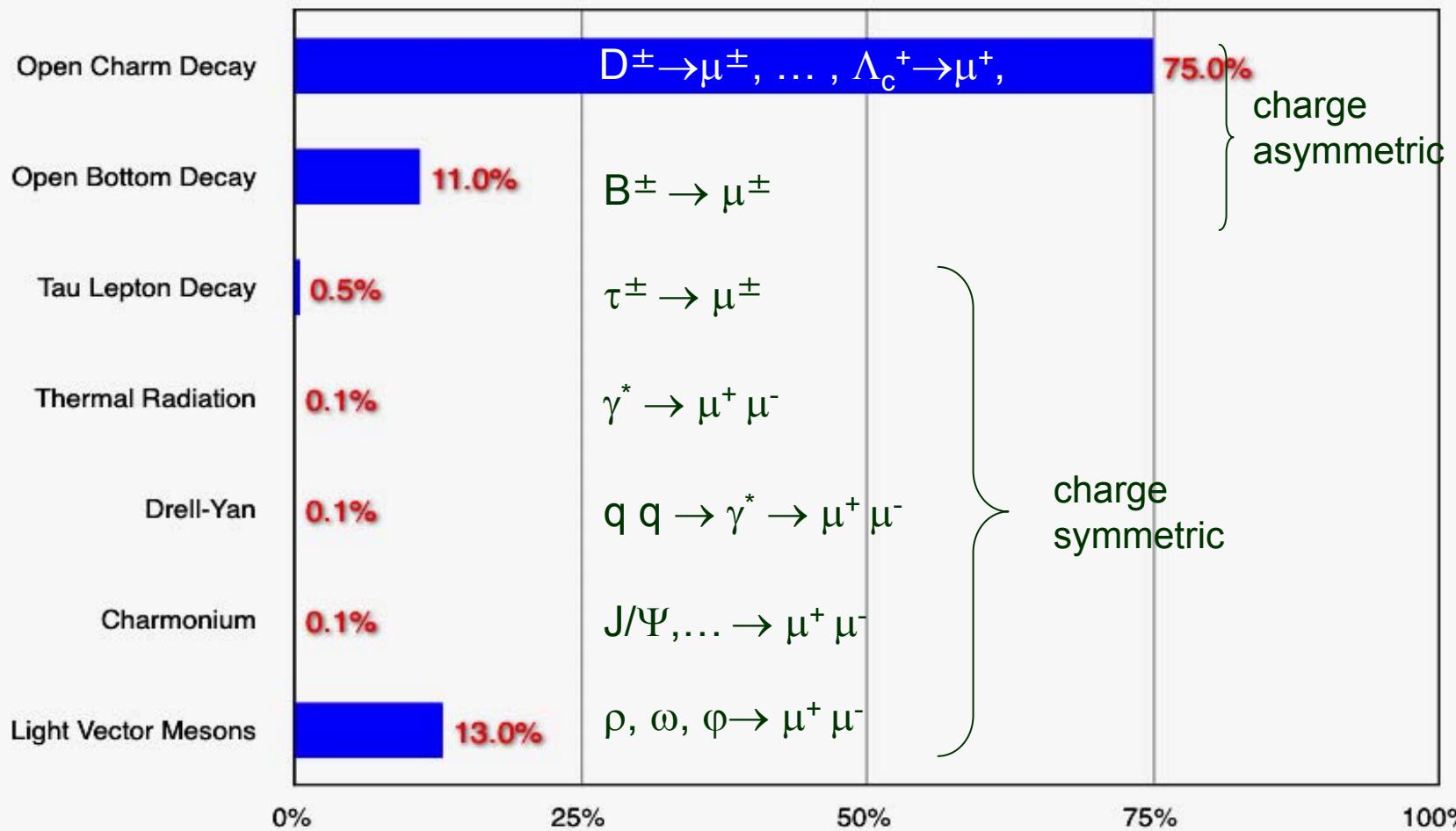
Analysis Techniques

Prompt μ background subtraction

- Punch-through hadrons:
Data driven method to Estimate
attenuation
- Decay muons: Vertex
distribution analysis

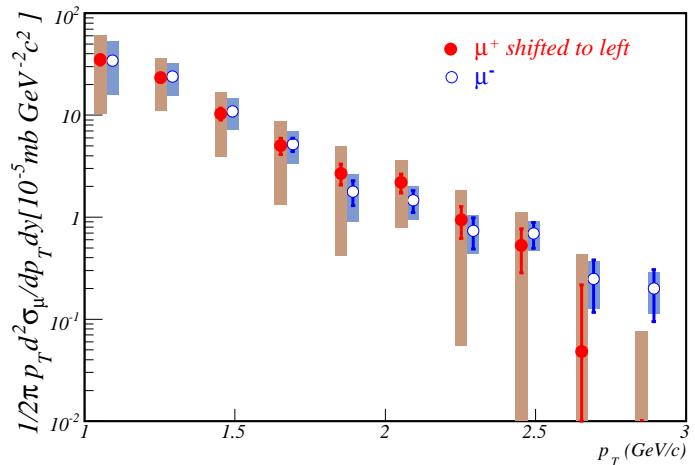


Sources of prompt muons ($p_T > 0.9\text{GeV}$) (determined from Pythia)



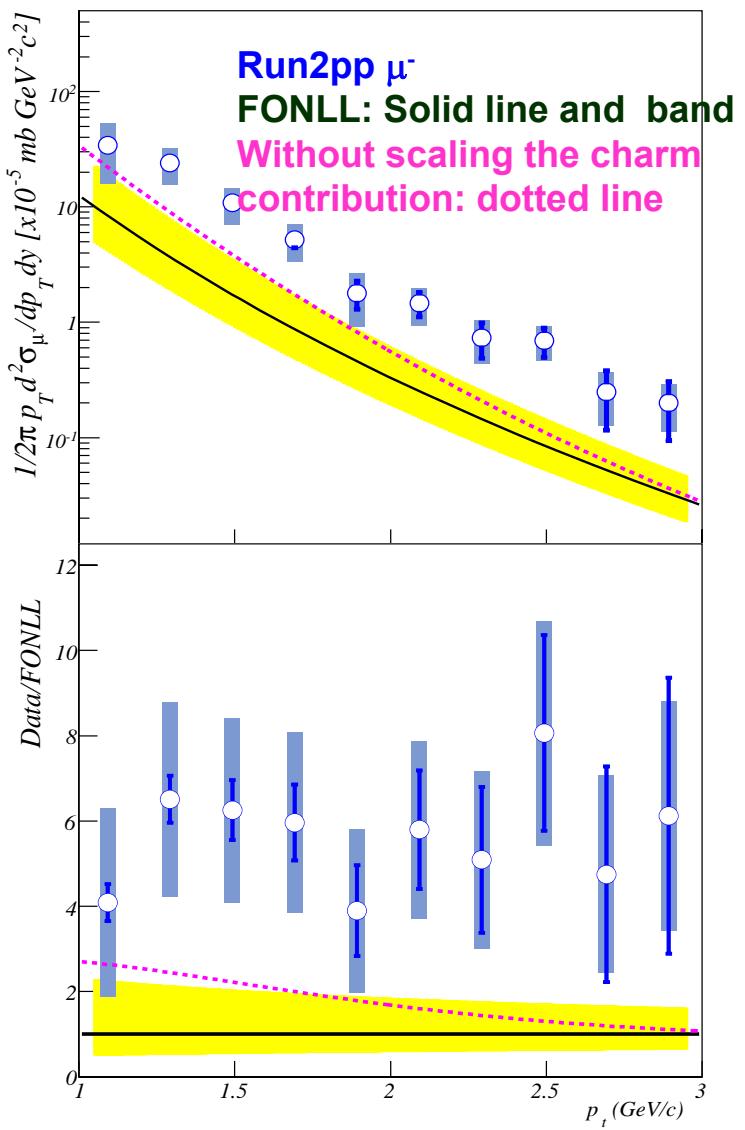
Comparison Prompt μ^- pt spectrum with theory

$$\frac{d\sigma_{cc}}{dy} \Big|_{y=1.6} = 0.243 \pm 0.013(stat.) \\ \pm 0.105(data.sys.)^{+0.049}_{-0.087}(pythia.sys)mb$$



FONLL: Fixed Order next-to-leading order terms
and Next-to-Leading-Log large p_T
resummation.

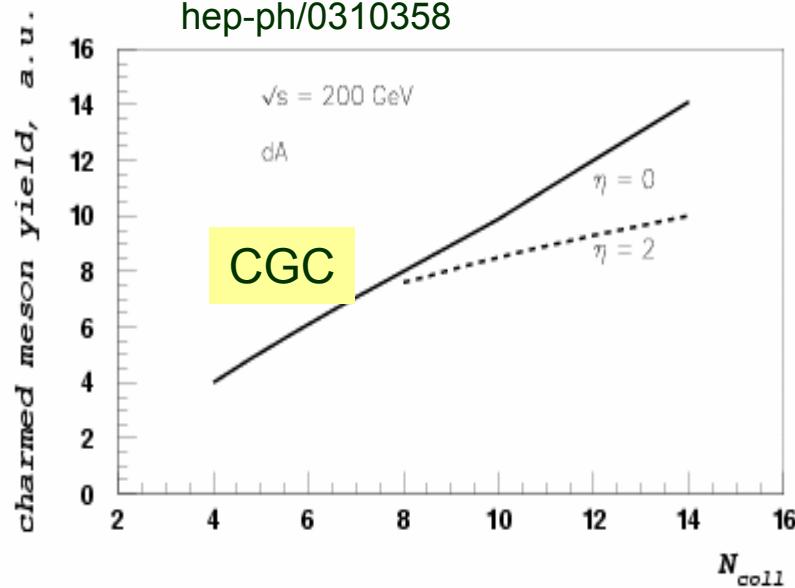
FONLL and PYTHIA calculation under
predicted PHENIX Data at forward rapidity,



Shadowing at Forward rapidity in dAu collisions

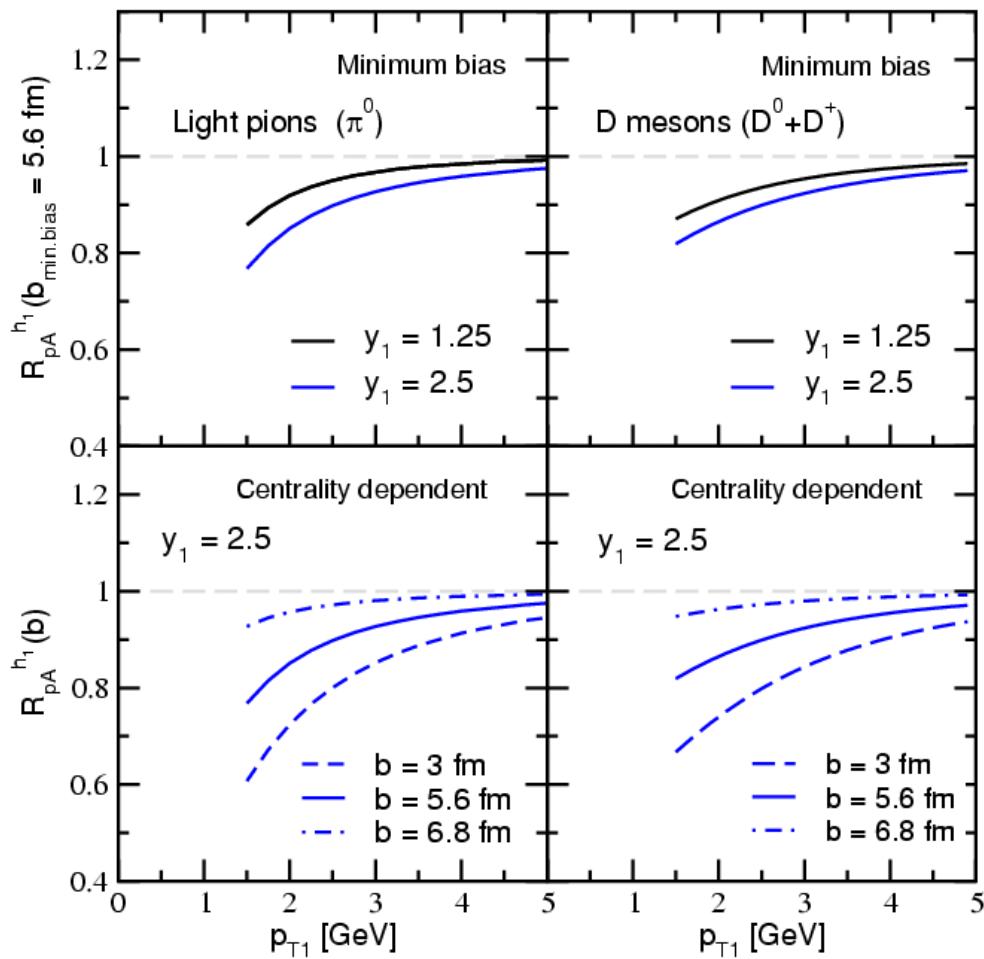
- Color Glass Condense
- Dynamic Multiple Scattering Power Correction

D. Kharzeev & K. Tuchin
hep-ph/0310358



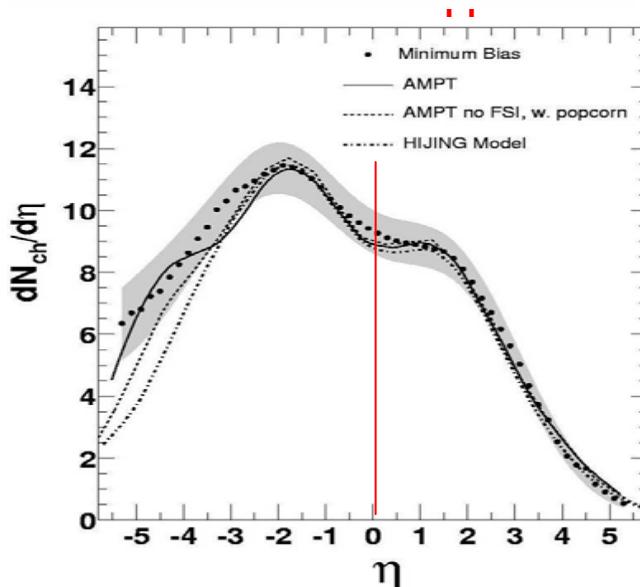
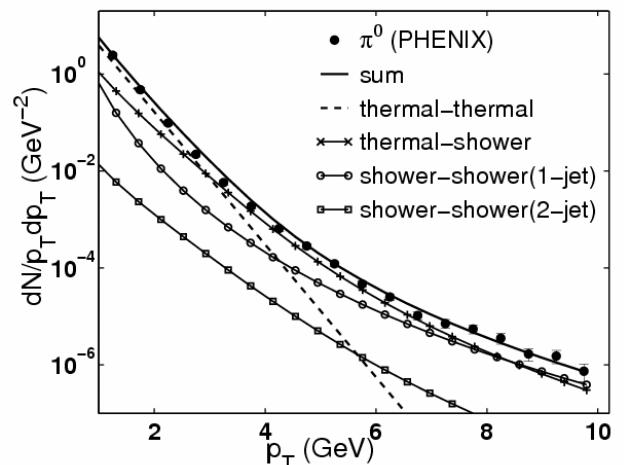
Power correction only

J. Qiu & I. Vitev



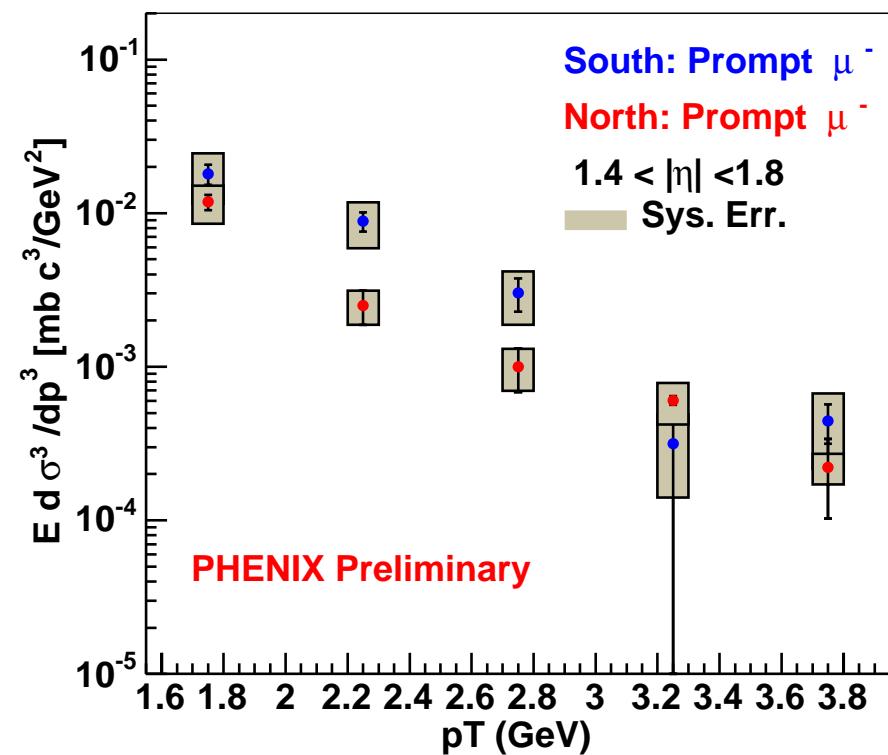
Recombination

- “Explains” light hadron yields in forward and backward rapidities
 - Input: low pT forward /backward hadron distributions
- Expect similar effects on open charm(?)
- Measurement of charm yields could provide additional constrains on these models

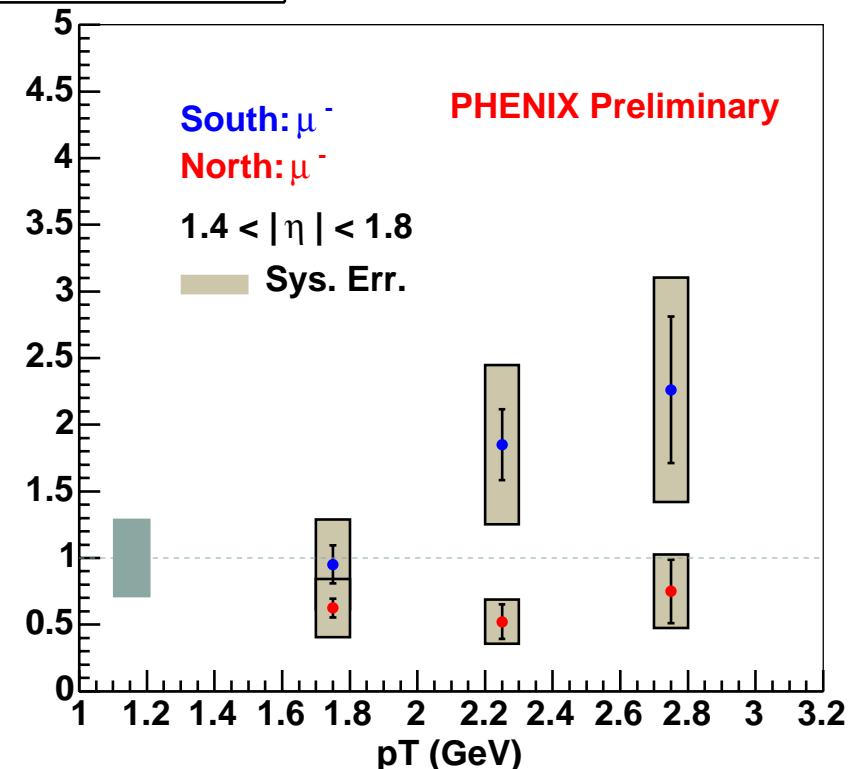


Prompt μ 's p_T spectra in dAu collisions and R_{dAu}

dAu Invariant cross section(prompt μ)



$R_{dAu}(\text{Prompt } \mu^-)$

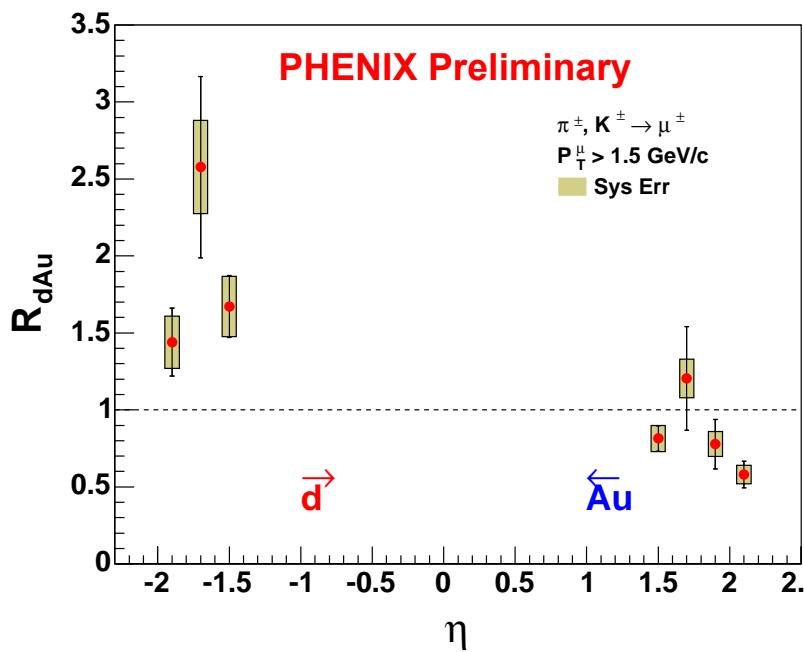


North Arm: d going direction;

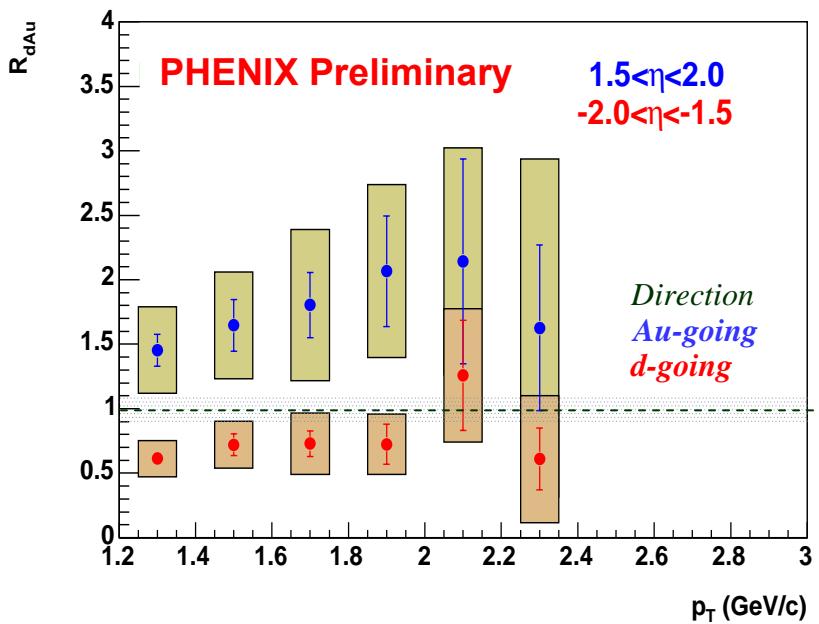
South Arm: Au going direction

Nuclear Modification Factor: R_{dAu} (decay μ from light hadrons)

R_{dAu} vs η



R_{dAu} vs p_T



Summary:

- **FONLL and PYTHIA 6.205 under predicted prompt μ at forward rapidity in pp collisions at 200 GeV.**
- **For muons from open heavy flavor decay, a suppression in forward rapidity is observed. It is consistent with CGC and power correction. Results are statistically limited.**
- **The mechanism of the observed enhancement at backward rapidity needs more theoretical investigation. Anti-shadowing and recombination could lead to such enhancement.**
- **Both Muon from light meson decay and heavy flavor decay show same behavior at forward and backward direction in dAu collisions.**

Backup

$$R_{dAu}(p_T, \eta) \equiv \frac{\frac{1}{2 \times 197} \frac{d^2\sigma^{d+Au \rightarrow \mu+X}}{dp_T d\eta}}{\frac{d^2\sigma^{p+p \rightarrow \mu+X}}{dp_T d\eta}}$$

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